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DESCRIPTION

IMAGE INPUT APPARATUS

5 Technical Field

The present invention relates to an image input apparatus and, more particularly, to a structure for effectively reducing stepwise differences in density between chips in an image sensor of an image scanner.

10

Background Art

Conventionally, in an image scanner which requires a large image sensor for reading a relatively large object, such as a desktop type, plural chips of the same standard are arranged
15 | adjacently, and an image of the object is read by employing output signals from the respective chips. The image scanner having such a structure initially measures gamma characteristics for each chip and compensates each gamma compensation value for each corresponding chip when an image is inputted, thereby resolving
20 | manufacture variations among the respective chips so as to obtain a fine image.

However, when chip characteristics are varied due to changes over time or the like, it is necessary to measure and compensate the gamma characteristics on all such occasions. In
25 | addition, when there are different gamma characteristics within

one chip, the effect appears in an image as the stepwise difference in density on the chip boundary, and such a case cannot be handled by this structure. Further, it is necessary ~~required~~ to provide a number of ~~many~~ memories on the scanner side to store gamma compensation values for the plural chips.

The conventional image input apparatus is ~~so~~ constructed in this manner, and labor that is involved in the maintenance of the plural sensor chips for the compensation of gamma characteristics due to the secular change and the number of many memories for storing gamma compensation values are necessary. Further, when there are different gamma characteristics within one chip, this cannot be handled, and as a result, whereby a fine image cannot be obtained.

The present invention is made to solve the above-described problems. Accordingly, an ~~and has for its object of the present~~ invention is to provide an image input apparatus which does not require maintenance such as a gamma characteristics compensation of a sensor chip due to the secular change and which can perform the compensation of gamma characteristics within one chip.

Disclosure Summary of the Invention

According to a first aspect ~~Claim 1~~ of the present invention, in an image input apparatus having an image reading unit which is constructed by arranging plural chips integrally, a stepwise difference in density between image signals which are

respectively read by adjacent chips consisting of plural read pixels, which chips have different reading sensitivities, is successively calculated at a time of image reading, and the image signals which are respectively read by the adjacent chips are compensated such that the difference in density between the image signals is compensated.

According to a second aspect Claim 2 of the present invention, the image input apparatus of the first aspect Claim 1 has a gamma compensation value only for one chip from among the plural chips as a reference (reference chip), and compensates the image signals for the reference chip as the reference and other chips by employing the gamma compensation value.

According to a third aspect Claim 3 of the present invention, in accordance with the image input apparatus of Claim 2 the second aspect, the stepwise difference in density of the image signals between the adjacent chips is calculated for image data which has been subjected to the compensation of the image signals by employing the gamma compensation value, and the stepwise difference in density is uniformly added to chips except for the reference chip as the reference.

According to a fourth aspect Claim 4 of the present invention, in accordance with the image input apparatus of Claim 2 the second aspect, the stepwise difference in density of the image signals between the adjacent chips is calculated for image data which has been subjected to the compensation of the image signals by

employing the gamma compensation value, and the stepwise difference in density is added to respective pixels in stages for chips except the reference chip ~~as the reference~~ from the end of the chips.

5 According to a fifth aspect ~~Claim 5~~ of the present invention, in accordance with the image input apparatus of any one of ~~Claims 1 to 4~~ the first through fourth aspects, in the calculation of the stepwise difference in density between the image signals, a difference of pixel data on the chip boundary is taken as the
10 stepwise difference in density between the image signals.

 According to a sixth aspect ~~Claim 6~~ of the present invention, in accordance with the image input apparatus of ~~Claim 5~~ the fifth aspect, in the calculation of the stepwise difference in density between the image signals, a mean of differences of pixel data
15 on chip boundaries for several lines is taken as the stepwise difference in density between the image signals.

 According to ~~Claim 7~~ a seventh aspect of the present invention, in accordance with the image input apparatus of ~~Claim 6~~ the sixth aspect, in the calculation of the stepwise difference
20 in density between the image signals, in a case where the mean of the differences of the pixel data on the chip boundaries for several lines is calculated, ~~when the difference exceeds a threshold value,~~ the difference value is excluded from the calculation of the mean when the difference exceeds a threshold
25 value.

According to ~~Claim 8~~ an eighth aspect of the present invention, in accordance with the image input apparatus of ~~Claim 6~~ the sixth aspect, in the calculation of the stepwise difference in density between the image signals, the calculation of the stepwise difference in density between the image signals is started after being delayed from the start of a real reading ~~start~~ by the number of lines which are required for calculating the mean value of the stepwise differences in density between the image signals.

According to a ninth aspect ~~Claim 9~~ of the present invention, in accordance with the image input apparatus of ~~Claim 8~~ the eighth aspect, the calculated stepwise difference in density is added from a first line of read image data, and last lines of the image data, by the number of which lines the calculation of the stepwise difference in density has been delayed, are not processed.

According to a tenth aspect ~~Claim 10~~ of the present invention, in accordance with the image input apparatus of ~~Claim 8~~ the eighth aspect, the calculated stepwise difference in density is added from a first line of read image data, and last lines of the image data, by the number of which lines the calculation of the stepwise difference in density has been delayed, are subjected to addition with a lastly calculated stepwise difference in density.

According to an eleventh aspect ~~Claim 11~~ of the present invention, in accordance with the image input apparatus of ~~Claim 8~~ the eighth aspect, the calculated stepwise difference in

density is added starting from a line of the read image data,
delayed by the number of lines which are required for calculating
the stepwise difference in density, and the lines from the start,
by the number of which lines the calculation is delayed, are
5 not processed.

According to a twelfth aspect ~~Claim 12~~ of the present
invention, in accordance with the image input apparatus of ~~Claim~~
& the eighth aspect, the calculated stepwise difference in
density is added starting from a line of the read image data,
10 delayed by the number of lines which are required for calculating
the stepwise difference in density, and an initially calculated
stepwise difference in density is added to the lines from the
start, by the number of which lines the calculation is delayed.

According to a thirteenth aspect ~~Claim 13~~ of the present
15 invention, in accordance with the image input apparatus of any
one of Claims 1 to 12 the first through twelfth aspects, when
a real-time screen display of an input image is performed, the
screen display is performed from a line which has been subjected
to the addition of the stepwise difference in density between
20 the chips.

According to a fourteenth aspect ~~Claim 14~~ of the present
invention, in accordance with the image input apparatus of ~~Claim~~
13 the thirteenth aspect, the calculated stepwise difference
in density is added from a first one of the read lines, ~~when~~
25 ~~last several lines are not processed~~, display is performed on

a screen from the first line when the last several lines are not processed, and the last several lines which are not processed are not displayed on the screen.

According to a fifteenth aspect ~~Claim 15~~ of the present invention, in accordance with the image input apparatus of ~~Claim 13~~ the thirteenth aspect, when the calculated stepwise difference in density is added from a line which is delayed by several lines, the line which is delayed by the several lines to the last line are displayed on the screen.

According to a sixteenth aspect ~~Claim 16~~ of the present invention, the image input apparatus of the first aspect ~~Claim 14~~ comprises: a density stepwise difference correcting means for, when the calculated stepwise difference in density is compared to a predetermined threshold value and the calculated stepwise difference in density is larger than the threshold value, correcting the calculated stepwise difference in density.

According to a seventeenth aspect ~~Claim 17~~ of the present invention, in accordance with the image input apparatus of ~~Claim 16~~ the sixteenth aspect, the density stepwise difference correcting means makes the stepwise difference in density zero ~~0~~ when the stepwise difference in density is larger than the threshold value, thereby correcting the calculated stepwise difference in density so as not to perform compensation of the stepwise difference in density between the image signals.

According to an eighteenth aspect ~~Claim 18~~ of the present

invention, in accordance with the image input apparatus of ~~Claim~~
16 the sixteenth aspect, the density stepwise difference
correcting means holds the stepwise difference in density at
a predetermined value so as not to be larger than the threshold
5 value when the stepwise difference in density is larger than
the threshold value.

According to a nineteenth aspect ~~Claim 19~~ of the present
invention, in accordance with the image input apparatus of ~~Claim~~
16 the sixteenth aspect, the density stepwise difference
10 correcting means calculates the difference by ~~with~~ increasing
the number of lines of pixels in chips for calculating the stepwise
differences in density when the stepwise difference in density
is larger than the threshold value.

According to a twentieth aspect ~~Claim 20~~ of the present
15 invention, in accordance with the image input apparatus of ~~Claim~~
1 the first aspect, the stepwise difference in density between
the image signals in reading subsequent to the start of reading
is compensated by employing a difference in density between the
image signals, which difference is calculated at the start of
20 reading.

According to a twenty-first aspect ~~Claim 21~~ of the present
invention, in accordance with the image input apparatus of ~~Claim~~
1 the first aspect, prereading for intermittently reading a
region is performed before reading is performed, and the stepwise
25 difference in density between the image signals is compensated

by employing the stepwise difference in density, which difference is calculated at the prereading.

According to a twenty-second aspect ~~Claim 22~~ of the present invention, in accordance with the image input apparatus of ~~Claim~~
5 21 the twenty-first aspect, the stepwise difference in density which is calculated at the prereading is calculated from a mean of all image data that is obtained in the prereading.

According to a twenty-third aspect ~~Claim 23~~ of the present invention, in accordance with the image input apparatus of ~~Claim~~
10 21 the twenty-first aspect, the stepwise difference in density which is calculated by the prereading is stored, and the stepwise difference in density between the image signals is compensated by employing the stored stepwise difference in density.

According to a twenty-fourth aspect ~~Claim 24~~ of the present invention, in accordance with the image input apparatus of ~~Claim~~
15 21 the twenty-first aspect, the stepwise difference in density between the image signals is compensated by applying, to a stepwise difference in density of an intermittent region which is not a target to be read, a stepwise difference in density
20 of a region which has been read immediately before the target region, at the prereading.

As described above, according to an image input apparatus of the present invention, in an image input apparatus having an image reading unit which is constructed by arranging plural
25 chips integrally, a stepwise difference in density between image

signals that are respectively read by adjacent chips consisting of plural read pixels, which chips have different reading sensitivities, is successively calculated at the time of image reading, and the image signals which are respectively read by the adjacent chips are compensated such that the stepwise difference in density between the image signals is compensated. Therefore, the stepwise difference in density on the chip boundary resulting from ~~the~~ changes over time or the difference of gamma characteristics within one chip can be made inconspicuous without making the user conscious.

Further, according to the image input apparatus of the present invention, the ~~this~~ apparatus has a gamma compensation value only for one chip from among the plural chips as a reference chip, and compensates the image signals for the reference chip ~~as the reference~~ and other chips by employing the gamma compensation value. Therefore, it is ~~only~~ required that the apparatus should hold only a gamma compensation value for one reference chip ~~as the reference~~, thereby saving necessary memory.

Further, according to the image input apparatus of the present invention, the stepwise difference in density of the image signals between the adjacent chips is calculated for image data which has been subjected to the compensation of the image signals by employing the gamma compensation value, and the stepwise difference in density is uniformly added to chips except

for the reference chip ~~as the reference~~. Therefore, the stepwise difference in density between the chips can be reduced by a simple operation.

Further, according to the image input apparatus of the present invention, the stepwise difference in density of the image signals between the adjacent chips is calculated for image data which has been subjected to the compensation of the image signals by employing the gamma compensation value, and the stepwise difference in density is added to respective pixels in stages for chips except the reference chip ~~as the reference~~ from the end of the chips. Therefore, even when a difference of the compensation values between the pixels which exist between the adjacent chips is large and the gamma characteristics greatly vary within one chip, the compensation is not performed excessively, and as a result, ~~whereby~~ more natural compensation of gamma characteristics can be performed.

Further, according to the image input apparatus of the present invention, in the calculation of the stepwise difference in density between the image signals, the density stepwise difference calculation means takes a difference of pixel data on the chip boundary as the stepwise difference in density between the image signals. Therefore, the stepwise difference in density on the chip interface can be effectively resolved.

Further, according to the image input apparatus of the present invention, in the calculation of the stepwise difference

in density between the image signals, a mean of differences of pixel data on chip boundaries for several lines is taken as the stepwise difference in density between the image signals.

Therefore, a smoother compensation of the stepwise difference
5 in density can be performed, and it can be expected to obtain a fine read image.

Further, according to the image input apparatus of the present invention, in the calculation of the stepwise difference in density between the image signals, in a case where a mean
10 of differences of pixel data on chip boundaries for several lines is calculated, when the difference exceeds a threshold value, the difference value is excluded from the calculation of the mean. Thereby, an error of the mean value due to an abnormal value or the like can be reduced.

15 Further, according to the image input apparatus of the present invention, the ~~this~~ apparatus comprises a density stepwise difference correcting means for, when the calculated stepwise difference in density is compared to a predetermined threshold value and the calculated stepwise difference in
20 density is larger than the threshold value, correcting the calculated stepwise difference in density. Therefore, there can be provided an image input apparatus with high reliability, without using a stepwise difference in density resulting from miscalculation for the compensation of characteristics between
25 the chips.

Further, according to the image input apparatus of the present invention, a stepwise difference in density is calculated at prescanning which is performed before real scanning, and the stepwise difference in density is used for compensating image signals at the real scanning. Therefore, the processing at the real scanning can be sped ~~speeded~~-up.

Brief Description of the Drawings

Figure 1 is a diagram illustrating a structure of an image input apparatus according to a first embodiment of the present invention.

Figures 2(a) to 2(b) ~~2~~-are diagrams for explaining a method for calculating the stepwise difference in density by the image input apparatus.

Figures 3(a) to 3(d) ~~3~~-are diagrams for explaining a method in a case where the stepwise differences in density are averaged and an average difference is uniformly added to chips by the image input apparatus.

Figure 4 is a diagram for explaining a method in a case where the stepwise differences in density are averaged and an average difference is added to chips in stages by the image input apparatus.

Figure 5 is a diagram illustrating a structure of an image input apparatus according to a second embodiment of the present invention.

Detailed Description of ~~Best Mode for Carrying out the Invention~~
First ~~Embodiment 1~~

Hereinafter, an image input apparatus according to a first
5 embodiment of the present invention will be described.

Figure 1 is a block diagram of the image input (reading)
apparatus according to the first embodiment. In ~~the figure 1,~~
numeral 1 denotes an image scanner, and numeral 11 denotes a
personal computer (PC) for compensating for a stepwise
10 difference in density, where the PC 11 ~~which~~ realizes a density
stepwise difference calculating means and a density stepwise
difference compensating means. Numeral 12 denotes a display
apparatus (CRT) for displaying a read image.

Further, an image sensor 2 constituting the image scanner
15 1 consists of a first chip 3 and a second chip 4, which are arranged
side by side in a direction that is orthogonal to the scanning
direction, and first and second amplifiers 5 and 6 which amplify
and output the outputs from the first and second chips 3 and
4, respectively.

20 The outputs of the first and second amplifiers 5 and 6
are converted into digital data by an ADC (analog-digital
converter) 7 in the latter stage. A shading compensation unit
8 performs a shading compensation for the digital-converted data
by using a shading coefficient of a RAM 10, and further, a gamma
25 compensation unit 9 performs gamma compensation by using a gamma

coefficient of the RAM 10.

Thereafter, the data is transferred to the PC 11, the density stepwise difference compensation is performed in the PC 11. Then, ~~and thereafter~~ the read-in image is displayed on the CRT 12.

~~The Next~~, the operation of the image input apparatus according to the first embodiment will now be described with reference to figures 1 to 4.

Initially, one of the first and second chips 3 and 4 is used as the reference chip, and a gamma compensation value of the chip is stored in the RAM 10. For example, when the first chip 3 is used as the reference chip, the gamma compensation value of the first chip 3 is stored in the RAM 10, and the gamma compensation unit 9 performs gamma compensation for both of the first and second chips 3 and 4 by using the gamma compensation value of the first chip 3 which ~~value~~ is stored in the RAM 10.

Next, a stepwise difference in density is calculated from pixel data on the boundary after performing the gamma compensation for the first and second chips 3 and 4. In figure 2(a), assume that 322 pixels from P_1 to P_{322} line up in the first chip 3, and 322 pixels from P_{323} to P_{644} line up in the adjacent second chip 4, that is, 644 pixels in total line up. Boundary pixels of the first and second chips 3 and 4 are the pixel P_{322} and the pixel P_{323} , and a density stepwise difference S between the first and second chips 3 and 4 is obtained by the following

Formula (1).

$$S = P_{322} - P_{323} \quad \text{Formula (1)}$$

Further, as shown in figure 2(b), the calculated stepwise difference S in density is uniformly added to the pixels P_{323} to P_{644} according to Formula (2), so that the stepwise difference
5 in density between the chips can be made inconspicuous.

$$P_{323}' = P_{323} + S \quad \text{Formula (2)}$$

$$P_{324}' = P_{324} + S$$

10

$$P_{644}' = P_{644} + S$$

Further, when the stepwise difference in density is calculated only by the read pixels P_{322} and P_{323} , there is a case where a correct stepwise difference in density cannot be
15 | calculated due to the influence of noise. Further, since P_{322} and P_{323} are disposed individually, there are deviations in the physical read positions, and as a result, ~~whereby~~ the stepwise difference in density originally existing on a manuscript may be calculated as the stepwise difference in density between the
20 chips.

Then, the stepwise differences in density are calculated
| on several lines by vertical scanning, and the calculated stepwise differences are averaged, thereby reducing an error in the calculation results. In figure 3(a), for example, when
25 the number of lines for calculating a mean value is n , the

respective density stepwise differences $S_1 \sim S_n$ of the lines $L_1 \sim L_n$ are calculated by the Formula (1), thereby obtaining a mean value by the following Formula (3) on the basis of this result.

$$m_1 = (S_1 + S_2 + \dots + S_n) / n \quad \text{Formula (3)}$$

5 The mean value $m_{1_}$ as the obtained result, is uniformly added to the pixels P_{323} to P_{644} as shown in figure 3(b). With respect to the next line L_2 , a mean value m_2 of the stepwise differences in density of the lines L_2 to L_{n+1} is calculated as shown in figure 3(c), and the mean value $m_{2_}$ as the obtained
10 result, is uniformly added to the pixels P_{323} to P_{644} as shown in figure 3(d). In this way, with respect to all of the lines, a mean value of the stepwise differences in density of n lines starting from a target line is obtained, and the mean value is added to a density value of the target line.

15 Here, in a case where there are excessive stepwise differences in density in some lines, the mean value of the stepwise differences in density is compared with a predetermined value or the like, and as a result, whereby no addition is performed when the mean value of the stepwise differences in
20 density is calculated, thereby enhancing the accuracy of a density stepwise difference compensation.

Further, as another addition method for adding the value of the stepwise difference in density to one chip so as to compensate for the stepwise difference in density, there is a
25 method by which the value is added in stages over several pixels

of the second chip 4. As an example, a method by which the value is added in stages for 10 pixels, assuming that the second chip 4 is composed of 10 pixels, will be described with reference to figure 4.

5 As described above, the mean value m is calculated, and this calculated mean value m is added to the pixels P_{323} to P_{332} with decreasing a value (a compensation value) in stages from the pixel P_{323} to the pixel P_{332} . By performing the compensation according to this method, for example even when the difference
10 of the gamma characteristics of the pixels which are close to the boundary between the adjacent chips is large, variations of the gamma characteristics within one chip are small, and an excessive compensation is not performed when a value to be compensated of a pixel in a slightly distant position is smaller
15 than that of a pixel existing on the chip boundary, and as a result, whereby the compensation process can be performed in stages in a natural manner. When this is formulated, 10 pixels from the pixel P_{323} to the pixel P_{332} are represented by the following Formula (4).

20 $P_{323}' = P_{323} + (m/10) * 10$ Formula (4)

$P_{324}' = P_{324} + (m/10) * 9$

.

.

$P_{332}' = P_{332} + (m/10) * 1$

25 In order to calculate a mean of the stepwise differences

in density as described above, the compensation process for a target line should be performed with being delayed by n lines which are required to calculate the mean. When this process is performed, the last n lines are used only for obtaining the mean, and thus the mean of the stepwise differences in density of the target line cannot be calculated. Then, a processing, such as abandoning data of the last n lines even when the data are read, adding the same value as the mean value m which is most recently ~~lastly~~ calculated before the process is performed to the last n lines, or decreasing the number of lines whose mean is calculated in stages, is performed.

Further, when the mean value m for the first n lines is added to L_n , contrary to the above-described method, a mean of the stepwise differences in density for the first n lines cannot be calculated. Then, it is possible that data of the first n lines are abandoned, the same value as the mean value m which is initially calculated as a mean of the stepwise differences in density is added to each of the first n lines, or the number of lines whose mean is calculated is increased in stages up to line n .

In a case where a read image is displayed on a screen in real time by employing an image reading apparatus which comprises the above-described structure for performing the density stepwise difference compensation process, data is displayed successively from a line for which the density stepwise

difference compensation process has been completed, and as a result, ~~whereby~~ reading of the image can be performed without making the user conscious of the density stepwise difference compensation process.

5 Further, also with respect to the display image, as described above, when the first n lines are abandoned, the first n lines are not displayed, and conversely, when the last n lines are abandoned, ~~conversely~~ the last n lines are not displayed.

By performing the processing as described above, the
10 stepwise difference in density between the chips can be made inconspicuous by a limited amount of memory ~~few memories~~ without the maintenance for the density stepwise difference compensation which should be performed by the user.

As described above, according to the first ~~this~~ embodiment,
15 the stepwise difference in density between pixels which are positioned in adjacent places to the adjoining chips 3 and 4 of the image sensor is obtained for plural lines and averaged, the stepwise difference in density between the chips is compensated for each line by employing each of the obtained mean
20 values, and thereafter, the image is read. Therefore, it is only required to provide a memory that holds the gamma compensation value for one chip as the reference for the density stepwise difference compensation, thereby suppressing an increase in the memory. Further, the density stepwise
25 difference between the chips can be always compensated for

regardless of the secular change without requiring action by
~~troubling~~ the user. In addition, variations of the gamma
characteristics within one chip can be also compensated, and
as a result, whereby a good read-in result can be obtained.

5 Further, the compensation value is varied in stages
according to the number of adjacent pixels for the chips except
for a chip as the reference, thereby compensating the stepwise
difference in density more naturally.

Second (Embodiment-2)

10 An Next, an image input apparatus according to a second
embodiment of the present invention will now be described.

Figure 5 is a block diagram of the image input apparatus
according to the second embodiment of the present invention.

In ~~the figure 5~~, numeral 11a denotes a PC (personal computer)
15 which realizes a density stepwise difference correcting means
as well as the density stepwise difference calculating means
and the density stepwise difference compensating means.

Hereinafter, the operation of the image input apparatus
of the second embodiment will be described. While the basic
20 operation of the image input apparatus of the second embodiment

is the same as that of the first embodiment, the mean of the
stepwise differences in density is calculated by using Formula
3, and thereafter, it is judged whether or not the calculated
density stepwise difference exceeds a predetermined value in
25 the PC 11a having the density stepwise difference correcting

means. When the calculated value exceeds the predetermined value, it is judged that the value is obtained as a result of a miscalculation or other factors, and the compensation amount is corrected to an appropriate value.

5 What is first considered as the cause of this miscalculation is a case where the calculated density stepwise difference is one which originally exists on the manuscript. In, and in this case, the density stepwise difference is corrected to 0 and the compensation is not performed.

10 What is secondly considered is a case where the calculated density stepwise difference is generated due to the influence of noise or the like. In, and in this case, the density stepwise difference is corrected to the same value as a prescribed value, and the image deterioration that is caused by performing
15 compensation with a larger value than the prescribed value is prevented. Further, the number of lines for calculating the mean is increased and the calculation is performed again. Accordingly, ~~whereby~~ the error in the calculation results is reduced, thereby preventing the image deterioration.

20 By performing the processing as described above, ~~it can be prevented that~~ an unnecessary compensation is prevented from being performed because of a stepwise difference in density due to miscalculation, which causes ~~thereby causing~~ the image deterioration.

25 Third (Embodiment 3)

~~An Next, an~~ image input apparatus according to a third embodiment of the present invention will now be described.

In the third ~~this~~ embodiment, the calculated difference in density is employed at the start of reading, and the compensation of image signals in subsequent readings ~~reading~~ following the initial ~~start of the~~ reading is performed.

That is, a difference of characteristics in each chip does not vary during the reading operation, and thus, after the density stepwise difference in each chip is calculated at the start of reading, the image signals which are ~~read~~ thereafter read can be compensated for by using the calculated value.

As described above, the stepwise difference in density which is calculated at the start of reading is employed for image signal compensation at the time of subsequent reading processes, thereby increasing a processing speed as compared with the method by which the stepwise difference in density is calculated in real time for each read line to perform the compensation of the image signals.

Fourth ~~(Embodiment 4)~~

~~An Next, an~~ image input apparatus according to a fourth embodiment of the present invention will now be described.

In the fourth embodiment, assume that a reading process is performed at high speed before reading data with degrading the resolution as compared with a real reading, that is, the so-called prescanning process is performed. This prescanning

process is a known process which is normally performed for deciding a read range of image data before actually reading the image. In the image input apparatus having such a prescanning function, the stepwise difference in density is previously
5 calculated at the prescanning, whereby it can be expected to increase the processing speed at real scanning.

Here, in the prescanning, in contrast to ~~unlike in the~~ real scanning, all image data are not read but the image data are thinned and read. Therefore, the mean of the density stepwise
10 differences of the respective lines, which differences are calculated at the prescanning, is calculated, and at real scanning the compensation is performed only by that value.

Further, the density stepwise differences of the respective lines, which differences are calculated at the
15 prescanning, are stored in a storage device (here, PC11 or PC11a), and ~~at the real scanning~~ the compensation is performed at the real scanning by the stored density stepwise differences of the respective lines. At this time, since the stored density
stepwise differences are the ones for the image data which have
20 been thinned for the prescanning, the calculated density stepwise differences themselves are also in a thinned state.
Thus, in a part having no data, that is, in a region where image data are thinned (practically in line units), the compensation is performed with reference to data of the immediately preceding
25 line.

As described above, according to the fourth ~~this~~ embodiment, the stepwise difference in density between the chips is calculated at the prescanning and employed at the real scanning, thereby increasing the processing speed at the real scanning.

5

Industrial Availability

A stepwise difference in density between image sensors in an image scanner is reduced by a simple arithmetic, thereby providing an image scanner which performs a maintenance
10 processing resulting from the secular change of image sensor chips without requiring action from ~~troubling~~ the user and which does not require a large amount of memory ~~many memories~~ for gamma compensation.

ABSTRACT

In an image input apparatus having an image sensor that
is composed of plural chips, the stepwise difference in density
on a chip boundary is made inconspicuous by a limited amount
5 of ~~few compensation memories~~ memory.

——The image input apparatus obtains the stepwise differences
in density between pixels that are positioned in ~~the~~ adjacent
places to adjoining chips of the image sensor and for plural
lines, ~~and~~ averages the differences, ~~and~~ reads an image, and
10 displays the same on a screen after compensating for the stepwise
difference in density between the chips for each line by using
the average value.